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PACKING CALIFORNIA POTATOES IN FIBERBOARD BOXES

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Agricultural Marketing Service

Marketing Research Division

UNITED STATES DEPARTMENT OF AGRICULTURE

THIS STUDY of shipping containers for potatoes is part of a broad program of research to improve methods of marketing farm products.

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February 1958

SUMMARY

Fiberboard boxes were compared with burlap bags for use as shipping containers for California White Rose potatoes during the spring of 1957. Five potato packing plants cooperated in this study. The fiberboard boxes cost more than burlap bags to pack but they protected the potatoes from bruising in transit much better than the bags.

Packing 100 pounds of potatoes in the new fiberboard boxes and loading them into the freight car cost 42 cents more than packing and loading the 100-pound bags, and cost 31 cents more than packing and loading 100 pounds of potatoes in 50-pound bags. 1/ The total materials cost per container for the 50- and 100-pound burlap bags and the 50-pound fiberboard box averaged 14.4, 18.6, and 28.6 cents, respectively. The average total labor cost per container for packing and loading the 50- and 100-pound burlap bags, and the 50-pound fiberboard box was 1.77, 2.35, and 2.96 cents, respectively.

The f.o.b. prices received by shippers of 12 carloads of potatoes packed in boxes and bags showed that an average premium of 51 cents per 100 pounds was received for potatoes packed in the fiberboard boxes.

The additional billed tare weight of a carload of potatoes packed in the new boxes amounted to 1,800 pounds. The freight charges per carload for this additional tare weight would amount to $24.30 if shipped to Dallas, Tex., and $35.64 if shipped to Miami, Fla., or about 7 and 10 cents, respectively, per hundredweight of potatoes.

Twelve test shipments of White Rose potatoes and 3 test shipments of round red potatoes packed in burlap bags and in fiberboard boxes were inspected at the terminal markets.

The comparative amounts of injury to White Rose potatoes packed in 50-pound boxes and 100-pound burlap bags were as follows:

Type of injury	In 50-lb. fiberboard boxes	In 100-lb. burlap bags
	Percent	Percent
Skinned and discolored	11.2	21.0
Slight bruising	0.5	14.9
Damage by bruising ...	0	0.6

A significant relationship was found to exist between the layer location of the burlap bag and bruising of the potatoes contained therein--bruising

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1/ Packing costs include only labor and packaging materials--do not include equipment costs, depreciation, taxes, interest, insurance, and other overhead and fixed costs. Labor cost is based on the total man-minute requirements per unit at an assumed hourly wage of $1.25.

increased from top to bottom layers. This type of relationship did not exist in the potatoes packed in fiberboard boxes.

Although there was a tendency for the fiberboard boxes loaded in the lower layers to compress slightly, this did not materially affect the appearance of the container or the protection it afforded the potatoes.

Wholesale trade reaction to the new boxes at the terminal market was generally favorable. They liked the boxes because they protected the potatoes from bruising and greening. A few wholesalers thought that the premium price might be a problem when potato prices were low; and one wholesaler in the face of a declining market claimed that there was a serious buyer resistance to the premium price asked for the potatoes in boxes.

It can be concluded, therefore, that in 1957, it cost about 51 cents more to market California White Rose potatoes in 50-pound fiberboard boxes than in 100-pound burlap bags. Of this 51 cents, 38.6 cents is for additional container costs; 3.6 cents for additional direct labor costs; and about 8-10 cents for additional freight costs. In 1957, potato shippers received a premium of about 51 cents f.o.b. California for potatoes packed in fiberboard boxes. Presumably, these additional costs of packing potatoes in fiberboard boxes will be about the same next season, except for possible economies in packing labor, and therefore a premium of about 40 to 50 cents per hundred pounds f.o.b. California would be necessary for the shippers to pack them profitably in boxes next year. What this premium may be next season or in subsequent seasons will depend primarily upon the demand for potatoes in this type of container.

PACKING CALIFORNIA POTATOES IN FIBERBOARD BOXES

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INTRODUCTION

This research project was undertaken to evaluate a new 50-pound fiberboard box for use in shipping California White Rose potatoes, in comparison with the conventional 100-pound burlap bag now in general use by potato shippers. Some 50-pound and 10-pound bags are also used but it is estimated that over 90 percent of these California potatoes are customarily shipped in 100-pound burlap bags. Since 1956, more shippers have been packing or are interested in packing potatoes in the new 50-pound box. As a result, there has arisen a need to analyze the advantages and disadvantages of the new 50-pound box with respect to container and material costs, labor requirements, arrival condition, and trade acceptance. It is estimated that in 1957 the equivalent of about 150 cars of California White Rose potatoes were packed and shipped in 50-pound fiberboard boxes.

In order to compare the 50-pound box with the 100-pound burlap bag, the following procedures were employed:

1. Time studies were conducted in 5 potato packingsheds in Kern County, Calif., in May and June 1957.

2. Methods of assembling, filling, and closing the new boxes were observed in each plant.

3. Materials, packing, and loading costs were recorded in each plant.

4. Twelve test shipments were originated and were inspected in the terminal markets. The general arrival condition of the potatoes packed in the new boxes was compared with that of those packed in the conventional 100-pound burlap bags.

The same studies listed above were also made on 50-pound burlap bags; but they were confined to 2 plants and 3 test shipments.

CONVENTIONAL CONTAINERS: 50- and 100-POUND BURLAP BAGS

Description of Burlap Bags

The conventional containers for bulk potatoes in California were the 50- and 100-pound burlap bags. The most widely used 100-pound bag measured approximately 36 inches in length and 23½ inches in width. It was made of 7½-ounce burlap. The tare weight ranged from 10 to 12 ounces. The 50-pound burlap measured approximately 29 x 19 inches. It was made of 7-ounce burlap. The tare weight ranged from 6 to 8 ounces.

Methods of Packing and Loading

The methods of handling, washing, sizing, and grading were the same whether the potatoes were packed in the 50- and 100-pound burlap bags, or in the new 50-pound fiberboard box. The potatoes to be packed into the bags moved directly from the grading tables to the packing tables, to which were attached 6 or 8 bagging heads.

Crews ranging from 7 to 14 men filled, weighed, closed, and loaded the bags. For example, a 7-man crew, commonly referred to as a "6-man front," consisted of 2 men filling the bags--the "jiggers"; 2 men weighing and closing the bags--the "sewers"; one man stacking the bags on handcarts--the "takeoff man"; and 2 men pushing the carts to the dock and loading the bags into freight cars or trucks--the "cartmen."

Each "jigger" operated 2 bagging heads. After filling one bag at the first head he diverted the potatoes to the second head. The filled bag was placed on a scale. The "jigger" then placed another empty bag on the first bagging head, thus alternately operating 2 bagging heads (fig. 1).

The "sewer" checked the weight of the bag, placed a shim on top of the potatoes, removed the bag from the scale, and closed it by sewing the opening with cord. The "jigger" and the "sewer" worked together as a unit.

After the sewer closed the bag, he dropped it on a conveyor belt leading to a table. Here, the "takeoff man" loaded the bags on handcarts. Five 100-pound bags or six 50-pound bags were placed on each handcart.

The 2 "cartmen" transported and loaded the bags into refrigerator cars or trucks. The standard load for a refrigerator car was usually a through load of 360 100-pound bags, 5 high and 3 across, or 720 50-pound bags, 6 high and 4 across (fig. 2).

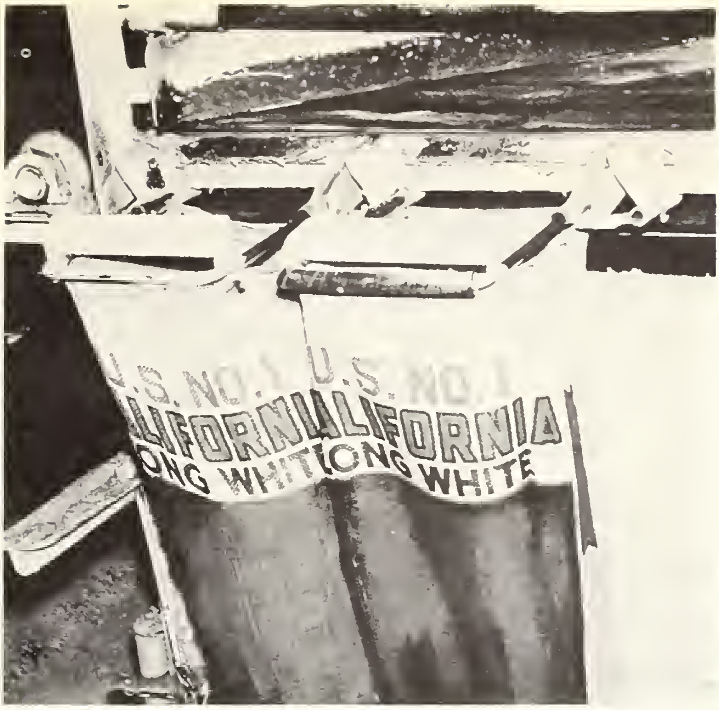

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Figure 1.--Bagging heads for 100-pound burlap bags.

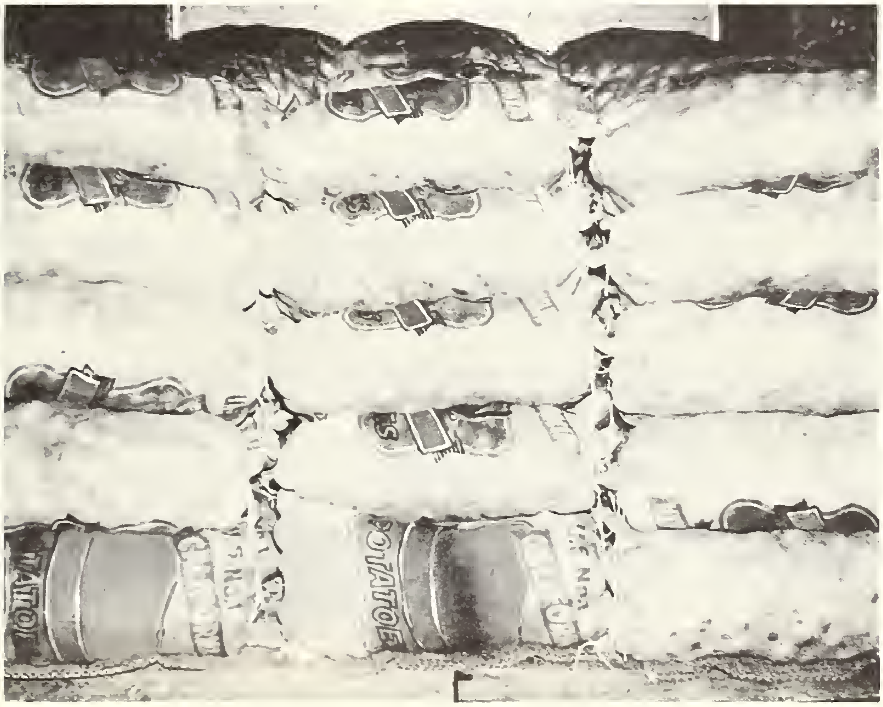

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Figure 2.--Standard load of 100-pound burlap bags, 5 high and 3 across.

EXPERIMENTAL CONTAINER: 50-POUND FIBERBOARD BOX

Description of Fiberboard Box

The experimental fiberboard box for bulk potatoes was a 2-piece full telescope box. The container held 50 pounds of potatoes. Inside dimensions were approximately 17 1/8 x 13 x 9½ inches with up to a 3/8-inch opening between top and bottom flaps. For ventilation the boxes had 2 vent slots, 3 inches long and ¼-inch wide, on each side, or they had 6 round holes, 1¼ inches in diameter, punched in the top and bottom flaps. Most of the boxes also had hand-holds in each end. These hand-holds measured 1 to 1¼ inches high by 3 to 3 3/4 inches long. The tare weight was approximately 2 3/4 pounds (fig. 3).

Methods of Packing and Loading

Various methods were employed to assemble, fill, and close the 50-pound fiberboard boxes. Because the 50-pound boxes are comparatively new to the potato industry, and the trade reaction uncertain, most of the packingplants did not want to invest in automatic machinery. Therefore, most of the packing lines set up for the 50-pound boxes were of simple design. The box assembling, packing, and loading were performed by 7 to 11 workers.

The different methods of performing the various operations, as observed in the 5 plants, are described below.

1. Assembling the box

Method 1.--Manual. In 3 plants 2 workers assembled the boxes manually. Three slight variations of methods were observed. These variations were:

A. With the aid of a wood forming block the bottom and top halves were formed and assembled. The top and bottom flaps were not stapled until after the box was filled.

B. The box was formed by hand. The bottom half was placed inside the top half. The bottom flaps were folded under, and the top flaps were left open until after the box was filled. The box then passed through a case sealer and the top and bottom flaps were sealed with glue.

C. Boxes had self-sealing adhesive applied to each flap by the manufacturer. One worker formed the bottom half, folded the flaps, and sealed them by tapping each corner with a mallet. A second worker, located beyond the weighing station, formed, folded, and sealed the cover by hand, and made it available to the closer.

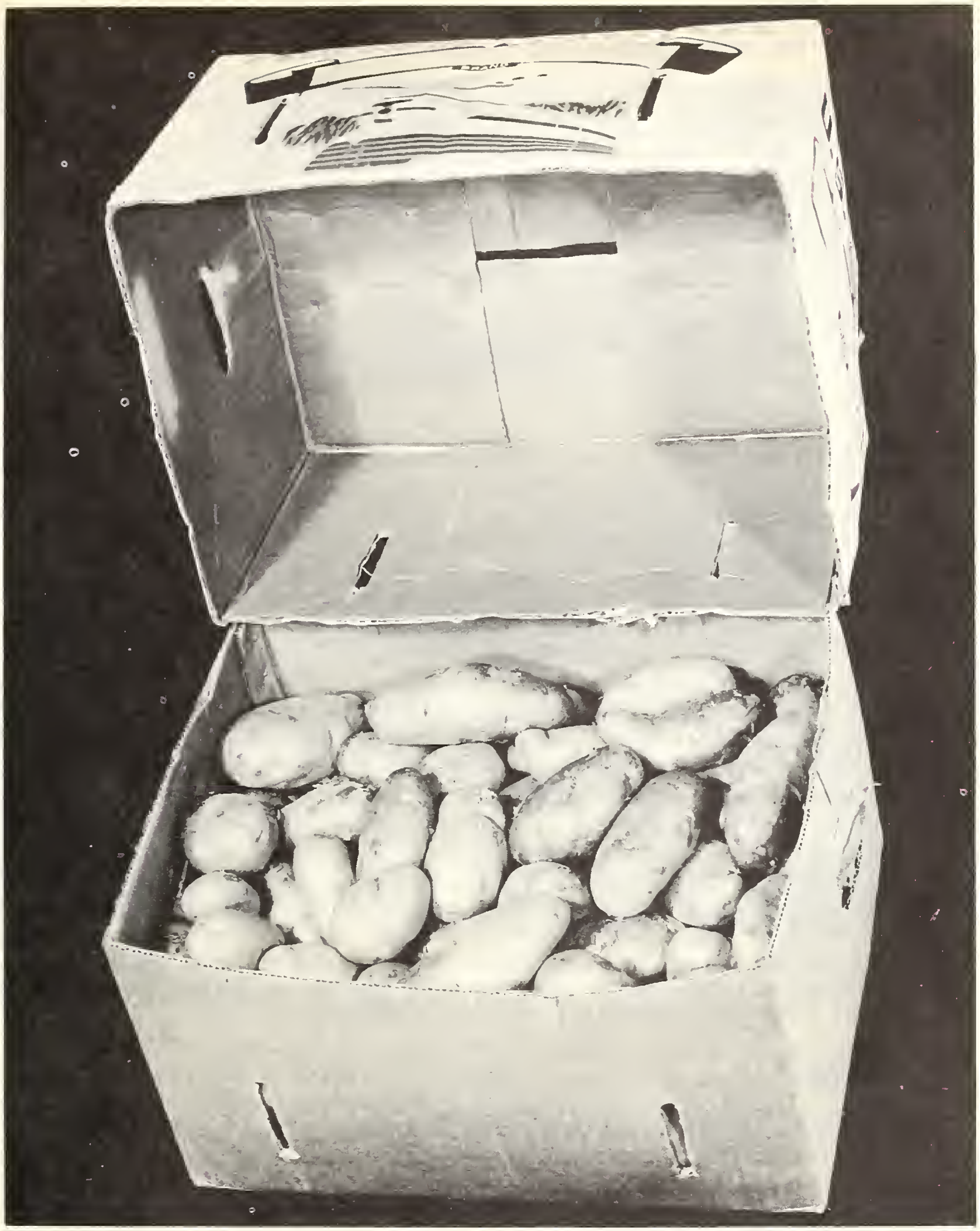

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Figure 3.--Fifty-pound 2-piece, full telescope, fiberboard box. Note ventilation slots on front and back, and hand grips on sides.

Method 2.--Semi-automatic. Two plants used a semi-automatic stapling machine. One worker formed and folded the boxes, another stapled the flaps.

2. Filling the box

Method 1.--Manual single chute. Three plants had a simple open chute operated by one worker. This worker centered empty boxes under the chute from which the potatoes poured until the box was filled. The potatoes were permitted to flow through the chute almost continuously. When necessary the worker operating the chute and filling the boxes slowed down the flow of potatoes by obstructing their passage with his hand. One worker supplied the filler with empty boxes by pushing them to him on a roller conveyor. When each box was filled, the chute operator pushed it along the roller conveyor towards the weighing station.

Method 2.--Manual double chute. One plant had 2 simple open chutes. One worker operated each chute. The boxes were supplied to the fillers by the worker who assembled the bottoms at a nearby location. After the filling operations, which were performed as in method 1, the boxes from both chutes were pushed by the fillers to a conveyor junction point. A "turn-boy" stationed at this point pushed the boxes from both chutes to the weighing station.

Method 3.--Automatic chutes. One plant used automatic filling machinery. This consisted of mechanical filling chutes and conveyor belts which did not require operators. From the box assembling station, the boxes moved on a belt conveyor to the chutes where they were automatically filled. When the boxes were filled they moved automatically to the weighing station (fig. 4).

3. Weighing

Weighing in all plants was done manually by a single worker. Four plants had scales built into the conveyor and one plant had a scale located beside the conveyor. The worker weighed each box and adjusted for under or overweight.

4. Closing

Method 1.--Manual with pre-assembled tops. In two plants one worker closed the boxes by placing pre-assembled tops over the filled boxes as they passed over from the weighing station to the loading station. The tops had been assembled previously with either staples or self-sealing adhesive.

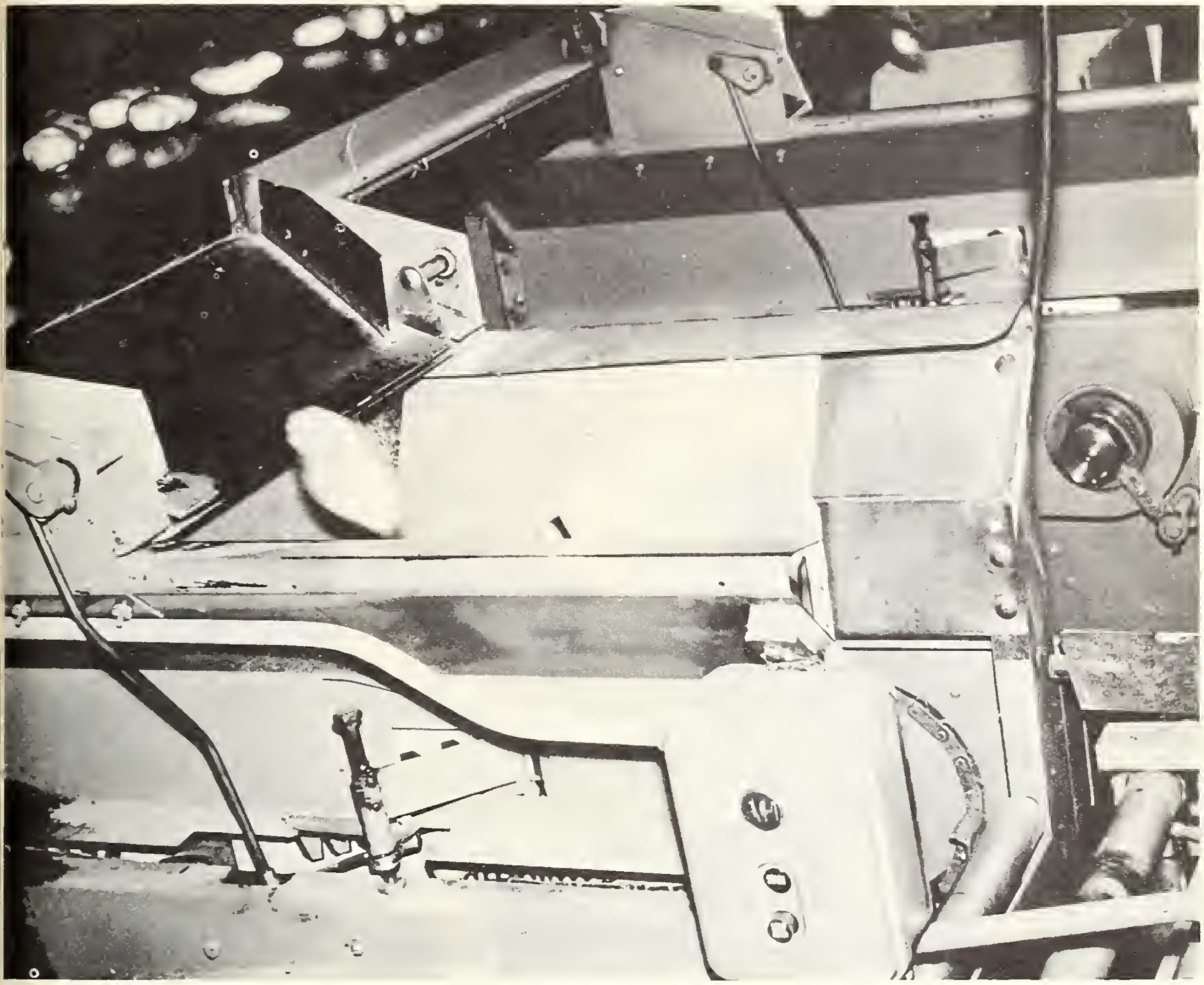

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Figure 4.--Automatic filling chute for 50-pound fiberboard box.

Method 2.--Semi-automatic stapling machine. Two plants closed the oxes with semi-automatic stapling machines. As a box passed through the achine, 4 staples were put in the top flaps and 4 in the bottom flaps. One orker operated the stapling machine and one worker folded the flaps down or the stapler (fig. 5).

Method 3.--Automatic case-sealer. One plant closed the tops and ottoms with an automatic case-sealer. As the boxes passed through the ase-sealer, the top and bottom flaps were folded and sealed with glue. One orker tended the case-sealer.

5. Loading

In each of the plants studied one worker loaded handcarts, and 2 orkers trucked them to the refrigerator cars where they were loaded.

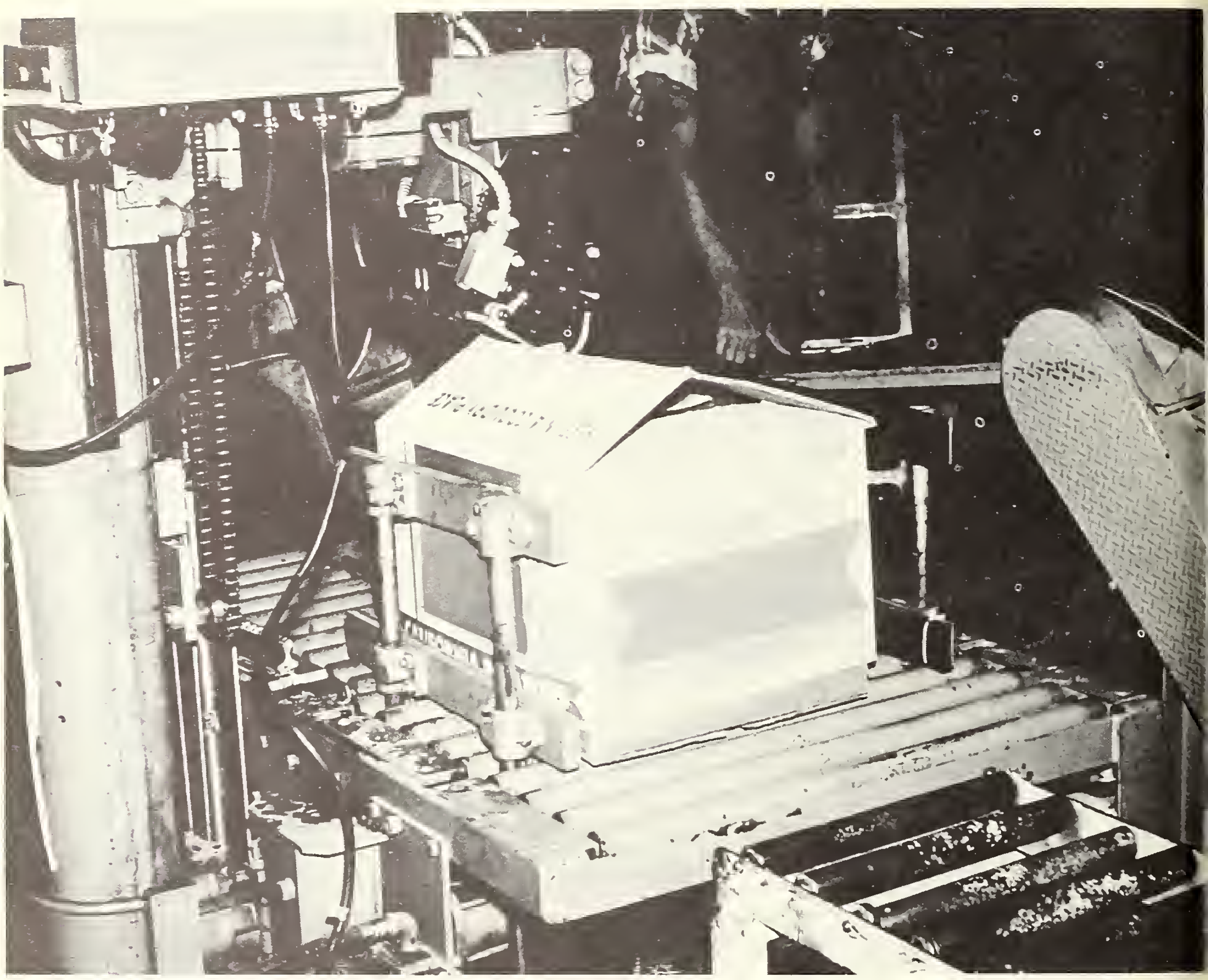

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Figure 5.--Semi-automatic stapling machine for closing the 50-pound fiberboard box

MATERIALS COSTS FOR 50- AND 100-POUND BAGS AND 50-POUND FIBERBOARD BOXES

A breakdown of the cost of materials for the 50- and 100-pound burlap bags and the 50-pound fiberboard boxes is shown in table 1. These figures, based on quotations received from packers and manufacturers, show that the total materials cost for the 50- and 100-pound bags averaged 14.4 and 18.6 cents, respectively. The total materials cost for the 50-pound fiberboard box averaged 28.6 cents.

Table 1.--Comparative cost of packing materials for packing California White Rose potatoes in 50- and 100-lb. burlap bags and 50-lb. fiberboard boxes, 5 plants, May 1957

Item	100-lb. burlap bag			50-lb. burlap bag			50-lb. fiberboard box		
	Cost per 1,000 bags	Cost per bag	Cost per carload (360 bags)	Cost per 1,000 bags	Cost per 2 bags	Cost per carload (720 bags)	Cost per 1,000 boxes	Cost per 2 boxes	Cost per carload (720 boxes)
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Containers	165.31	.1653	59.51	125.42	.2508	90.30	271.27	.5425	195.31
Closures:									
Bags:									
Cord	6.66	.0067	2.40	6.66	.0133	4.80	---	---	---
Shims	3.53	.0035	1.27	3.53	.0071	2.54	---	---	---
Boxes:									
Staples	---	---	---	---	---	---	16.50	.0330	11.88
Glue	---	---	---	---	---	---	5.00	.0100	3.60
Floor pads 1/..	10.00	.0100	3.60	8.35	.0167	6.01	---	---	---
Total:									
Bags	185.50	.1855	66.78	143.96	.2879	103.65	---	---	---
Boxes closed by:									
Staples	---	---	---	---	---	---	287.77	2/ .5755	2/ 207.19
Glue	---	---	---	---	---	---	276.27	2/ .5525	2/ 198.91

1/ Cost is calculated at 200 floor pads per 1,000 100-lb. bags; and 167 floor pads per 1,000 50-lb. bags.

2/ Four plants closed boxes by staples and one plant by glue; therefore, weighted average material cost per box and per carload of potatoes amount to $0.2855 and $205.56, respectively.

Thus, materials for two fiberboard boxes cost 38.6 cents more than one 100-pound burlap bag and two 50-pound burlap bags cost 10.2 cents more than one 100-pound burlap bag. On a carlot basis, costs of packaging materials were about $139 and $37 more, respectively, for potatoes in 50-pound fiberboard boxes and 50-pound burlap bags than for 100-pound burlap bags. As shown in table 1, materials included shims and cord for bags as well as floor pads for the car. Floor pads are not used for cars loaded with fiberboard boxes and only the additional cost of the glue or staples to close them was included.

DIRECT LABOR REQUIREMENTS AND COSTS OF PACKING AND LOADING POTATOES IN 50- AND 100-POUND BAGS AND IN 50-POUND FIBERBOARD BOXES

The potatoes packed in the burlap bags and fiberboard boxes were handled identically until after they were graded. At this point, the potatoes moved either directly to the bag packing table, or were diverted to the box packing line. Therefore, for the purpose of comparison, direct labor costs have been calculated from this point on in the production line (after they have been graded) through the final loading into the refrigerator car.

Because some of the men on the box packing line were paid on a piece rate basis and others were paid on an hourly basis, direct labor costs for both the bagging and boxing operations are based on the total man-minute requirements per unit at an assumed hourly wage of $1.25.

The 50- and 100-Pound Burlap Bags

In the 5 plants observed all packers and loaders were paid on a piece work basis. This piece work rate depended on the number of men in the crew and it ranged from 33 cents per man for a 14-man crew to 60 cents per man for a 7-man crew, per 100 100-pound bags. The rate was 30 cents per man for a 14-man crew to 45 cents per man for a 7-man crew per 100 50-pound bags.

The average direct labor used per 100-pound bag for the filling, weighing, closing, and loading operations in 5 plants was 1.13 man-minutes after allowances for personal time and fatigue (table 2). The most efficient plant used 0.86 man-minutes and the least efficient plant used 1.46 man-minutes. In 2 plants the average direct labor used for packing and loading 50-pound bags was 0.85 man-minutes, or 1.70 man-minutes per 100 pounds of potatoes.

Applying the assumed $1.25 hourly wage, the average direct labor cost in the 5 plants for packing and loading 50- and 100-pound burlap bags was 1.77 cents and 2.35 cents, respectively.

Table 2.--Comparison of the average amount of direct labor used to pack and load 100 pounds of potatoes, burlap bags and fiberboard boxes 1/

Operation	5 plants	2 plants	5 plants
	100 lbs. of potatoes packed in 100-lb. burlap bags	100 lbs. of potatoes packed in two 50-lb. burlap bags	100 lbs. of potatoes packed in two 50-lb. fiberboard boxes
	Man-minutes	Man-minutes	Man-minutes
Assembling container	0.0	0.0	.86
Filling	.32	.48	.38
Turn boy	0.0	0.0	.05
Weighing	2/	2/	.26
Closing	.33	.50	.36
Loading	.48	.72	.94
Total	1.13	1.70	2.85

1/ Allowance made for 5 percent personal time, and 25 percent fatigue time for 100-lb. bags and 15 percent fatigue time for 50-lb. bags and boxes.
2/ Weighing of bags performed while closing.

The 50-Pound Fiberboard Box

In addition to piece-rate men performing the filling, closing, and loading operation on the box packingline, men paid by the hour assembled, weighed, and assisted the filler and the operators who closed the boxes.

In 4 of the 5 plants observed most of the operations were performed manually. For example, in one plant the packingline consisted of 10 men. Two men assembled the fiberboard boxes--one folded and placed the bottom half over a forming block and the other man folded and placed the top half over the bottom half. The forming block held the bottom half in shape and in place during the assembling operation. The man assembling the tops removed the box and placed it on a roller conveyor belt leading to the filling chute. Another man pushed or fed the boxes along the roller conveyor to the man filling the boxes. After the boxes were filled, the filler pushed the boxes to a man check-weighing, and in turn received another empty box from the feeder. After the boxes were weighed, one man prepared the boxes for closing and pushed them to the closing operator. Three men, one take-off man and 2 cartmen, handled the loading operation.

In contrast to the above packingline, one plant filled the boxes with 2 automatic chutes, and closed the boxes with an automatic case-sealer. Only 7 men were needed for this packingline as follows: Two assembling and placing the boxes on an automatic feeding belt leading to the chutes; one weighing the boxes; one preparing the boxes for the case-sealer; and 3 men for the loading operation.

The average direct labor used to fill, assemble, weigh, close, and load 100 pounds of potatoes in two 50-pound fiberboard boxes was 2.85 man-minutes (table 2).

The hourly-paid labor used on the box packinglines was paid $1.25 per hour. The filling, closing, and loading men received the same piece rate as the men on the 50-pound burlap bag packingline. However, for purposes of comparison, all direct labor costs are calculated on the basis of an assumed wage rate of $1.25.

Comparison of Labor Costs

The average cost of direct labor used to pack and load potatoes in the 3 containers, as determined by labor requirements and based on a $1.25 hourly wage, was as follows: 2/

Container	Average direct labor cost	
	Per container	Per 100 pounds
	Cents	Cents
100-lb. burlap bag	2.35	2.35
50-lb. burlap bag	1.77	3.54
50-lb. fiberboard box	2.96	5.92

The average additional labor costs per 100 pounds and per carload of 36,000 pounds of potatoes packed in 50-pound burlap bags and 50-pound fiberboard boxes as compared with the 100-pound burlap bag were as follows:

Container	Per 100 lbs.	Per carload
	Dollars	Dollars
50-lb. burlap bag	.0119	4.28
50-lb. fiberboard box	.0357	12.85

2/ Actual costs of packing potatoes in burlap bags was about 2 to 2.5 cents more 100-pound bag and 1.5 cents more per 50-pound bag when calculated on a piece-rate basis than when calculated on a 1.25-cent per hour wage rate. The fiberboard boxes were generally packed on experimental lines, mostly manned by employees paid on an hourly basis in 1957, but it is possible that, if they were widely adopted, piece-rate wage rates would be developed for packing them.

COMBINED MATERIALS AND DIRECT LABOR COSTS

Table 3 shows the cost of direct labor used and the total materials costs for the 50- and 100-pound burlap bag, and the 50-pound fiberboard box.

The average additional labor and materials cost of the fiberboard box and the smaller burlap bag as compared with that for the 100-pound burlap bag was as follows:

Container	Additional direct labor and materials cost	
	Per 100 lbs. potatoes	Per carload of potatoes
	Dollars	Dollars
50-lb. burlap bag	.1143	41.15
50-lb. fiberboard box	.4212	151.63

COMPARISON OF FREIGHT RATES FOR SHIPPING POTATOES IN FIBERBOARD BOXES AND IN BAGS

The 50- and 100-pound burlap bags and the fiberboard box were billed at 50½, 101, and 53 pounds, respectively. The gross billing weight for a carload of 720 50-pound bags and 360 100-pound bags was 36,360 pounds. The gross billing weight for a carload of 720 fiberboard boxes was 38,160 pounds. To ship approximately 36,000 pounds of potatoes in the fiberboard boxes the shipper must pay for an additional weight of 1,800 pounds.

Table 4 shows the extra freight charges per carload for shipping potatoes in fiberboard boxes to 6 markets. From Kern County to New York, N. Y., the extra freight charge for an equivalent carload was $35.10 for shipping potatoes in fiberboard boxes instead of in 50- and 100-pound burlap bags.

The refrigeration charges are not included since they are assumed to be the same in either case.

COMPARISON OF F.O.B. PRICES RECEIVED FOR POTATOES PACKED IN BURLAP BAGS AND FIBERBOARD BOXES

The f.o.b. prices received by shippers of 15 test shipments of mixed carloads of potatoes packed in burlap bags and fiberboard boxes are shown in table 5. Twelve cars contained an average of 337 boxes and 193 100-pound bags. Three cars contained an average of 340 boxes and 380 50-pound bags. From the 10 carloads containing the same brand of White Rose potatoes the shippers received 50 cents more per hundred from 9 shipments, and 60 cents

Table 3.--Costs of materials and direct labor used for packing White Rose potatoes in burlap bags and fiberboard boxes, May 1957

Item	100-lb. burlap bag		50-lb. burlap bag			50-lb. fiberboard box		
	Cost per 100-lb. bag	Cost per carload (360 bags)	Cost per 50-lb. bag	Cost per 100-lb. equivalent (2 bags)	Cost per carload (720 bags)	Cost per 50-lb. box	Cost per 100-lb. equivalent (2 boxes)	Cost per carload (720 boxes)
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Direct labor used at $1.25 per hour	.0235	8.46	.0177	.0354	12.74	.0296	.0592	21.31
Packaging materials .	.1855	66.78	.1440	.2880	103.68	.2855	.5710	205.56
Total	.2090	75.24	.1617	.3234	116.42	.3151	.6302	226.87

Table 4.--Comparison of railroad freight rates for shipping White Rose potatoes packed in 50- and 100-pound burlap bags and in 50-pound fiberboard boxes, including 3 percent Federal transportation tax, spring 1957

Destination	50- and 100-lb. burlap bags 1/			50-lb. fiberboard box			Extra freight charge for boxes
	Gross billing weight for 360 101-lb. bags 2/	Freight rate per 101-lb. bag 2/	Total freight rate per 360 101-lb. bags 2/	Gross billing weight for 720 53-lb. boxes	Freight rate per 53-lb. box	Total freight rate per 720 53-lb. boxes	
	Pounds	Dollars	Dollars	Pounds	Dollars	Dollars	Dollars
Dallas, Tex. ..	36,360	1.364	490.86	38,160	.7155	515.16	24.30
Memphis, Tenn.	36,360	1.545	556.31	38,160	.8109	583.85	27.54
Chicago, Ill. .	36,360	1.606	578.12	38,160	.8427	606.74	28.62
Buffalo, N. Y.	36,360	1.808	650.84	38,160	.9487	683.06	32.22
New York, N. Y.	36,360	1.970	709.02	38,160	1.0335	744.12	35.10
Miami, Fla. ...	36,360	2.000	719.93	38,160	1.0494	755.57	35.64

1/ The Atchison, Topeka and Santa Fe Railway Company, Potato Rates, Fresno, Calif., pp. 3, 4, 9, 12, April 1, 1957.

2/ The billing weight for 50-pound bags is 50.5 pounds. Two 50-pound bags are equivalent to one 100-pound bag.

Table 5.--Comparison of Kern district f.o.b. price of 100 pounds of potatoes packed in burlap bags and fiberboard boxes, 15 mixed carloads, May 1957

Test shipment No.	Variety or type	Terminal market	Burlap bag (100-lb.)	Fiberboard boxes (two)	Burlap bag (two 50-lb
			Dollars	Dollars	Dollars
1 ..	White Rose	Buffalo, N. Y.	2.75	3.25	---
2 ..	do.	do.	2.75	3.25	---
3 ..	do.	do.	2.75	3.25	---
4 ..	do.	do.	2.60	3.10	---
5 ..	do.	do.	2.60	3.10	---
6 ..	do.	Mansfield, Ohio	2.00	2.60	---
7 ..	do.	Cleveland, Ohio	2.35	2.85	---
8 ..	do.	Buffalo, N. Y.	2.15	2.65	---
10 ..	do.	do.	1.70	1/1.95	---
11 ..	do.	Rutherford, N. J.	---	2.10	1.65
12 ..	do.	Pittsburg, Pa.	---	2.15	1.65
12 ..	Round red	do.	---	1/2.10	1.35
13 ..	White Rose	Miami, Fla.	2.05	2.55	---
15 ..	Round red	Pittsburg, Pa.	---	2.10	1.25
16 ..	White Rose	Johnstown, Pa.	1.50	1/2.25	---
19 ..	do.	Buffalo, N. Y.	2.15	2.65	---
Average 100-lb. bag and 50-lb. box (White Rose)			2.28	2.79	---
Average 50-lb. bag and 50-lb. box (White Rose)			---	2.13	1.65
Average 50-lb. bag and 50-lb. box (round red)			---	2.10	1.30

Price premium (per hundredweight) for 50-lb. boxes:

Over 100-lb. bags (White Rose)	.51
Over 50-lb. bags (White Rose)	.48
Over 50-lb. bags (round red)	.80

1/ Different brand of potatoes in each container.

more per hundred from one shipment, for potatoes packed in the boxes than in 100-pound burlap bags. Two different brands of potatoes were packed in each of 2 carloads. In these 2 shipments, 25- and 75-cent premiums were received for the potatoes in boxes. These differences in premiums could probably be attributed to the differences in brands. Shippers generally charged a 50-cent premium for potatoes packed in fiberboard boxes in 1957, to cover their anticipated additional costs. Not enough test shipments of potatoes were made of 50-pound bags compared with 50-pound boxes to warrant any conclusions on price differentials for these 2 containers. It is unknown, of course, what the price premiums for potatoes packed in fiberboard boxes over burlap bags are likely to be in future years, because they will depend primarily upon the market demand for potatoes packed in such containers.

EVALUATION OF THE FIBERBOARD BOXES AT DESTINATION MARKETS

A total of 15 railroad test shipments of potatoes from California to eastern terminal markets was made in the spring of 1957. These test shipments consisted of mixed loads of potatoes packed in fiberboard boxes and in burlap bags. The fiberboard boxes were loaded 3 chimneys wide, 5 high (fig. 6). The 100-pound and 50-pound bags were loaded in the conventional manner, 5 and 6 high and 3 and 4 wide, respectively.

Of the 15 test shipments, 12 contained 50-pound boxes and 100-pound burlap bags, and 3 contained 50-pound boxes and 50-pound bags. The containers and variety of potatoes used in these shipments were as follows:

	No. of test shipments
White Rose potatoes:	
50-lb. boxes and 100-lb. bags	12
White Rose potatoes:	
50-lb. boxes and 50-lb. bags	2
Round red potatoes:	
50-lb. boxes and 50-lb. bags	2

One test shipment contained both White Rose and round red potatoes packed in 50-pound boxes and 50-pound bags.

Researchers observed container damage and appearance, the condition of the potatoes packed in the different containers, handling of the containers, and the wholesale trade reaction to the containers.

Container Damage

With few exceptions the fiberboard boxes sustained very little damage during shipment. The exceptions were those boxes loaded adjacent to the stacks of burlap bags. In this type of load the boxes loaded adjacent to the

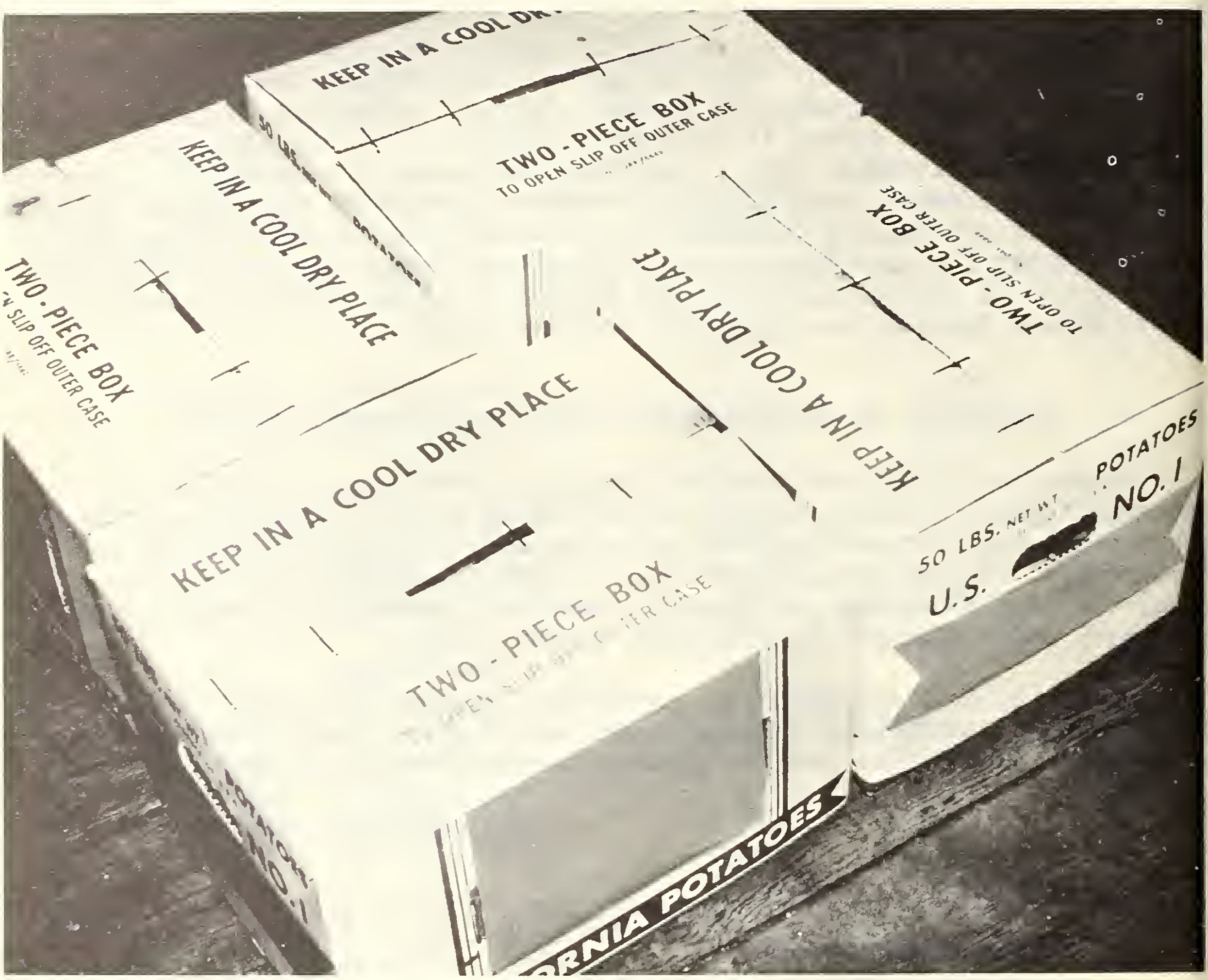

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Figure 6.--Bottom layer of a chimney load.

bags showed ends and sides pushed in, creasing, chafing, and stains from the printing on the bags. Only 2 boxes in the 15 test shipments were torn. These 2 boxes were seriously compressed by shifting bags and a corner of the cover was torn in each case. There was a tendency for the boxes in the lower layers to compress slightly. This condition was most pronounced in the bottom layer. Some compression also occurred in the second to fourth layers when the boxes had absorbed a small amount of moisture and lost some of their rigidity. Once the boxes were unloaded, evaporation was rapid and the boxes became more rigid.

Container Appearance

As compared with the burlap bag, the box, printed with a white background, had a clean and bright appearance. By simply removing the cover, the wholesalers displayed the potatoes neatly and attractively. The over-all appearance of a display of potatoes in these boxes against a background of neatly stacked white boxes was a favorable contrast to the usual appearance of a display of potatoes in burlap bags.

Arrival Condition of Potatoes

As the potatoes were examined at the terminal markets, inspectors noted 5 types of product damage. These were: (1) "Skinned--not discolored," (2) "skinned--discolored," (3) "bruised," (4) "greened," and (5) "decayed." Results of these terminal market examinations are shown in table 6. The text which follows discusses only the 12 shipments of White Rose potatoes packed in 100-pound burlap bags and in the new 50-pound fiberboard boxes. The remaining shipments of 2 varieties of potatoes in 50-pound bags and in 50-pound boxes were not sufficient in number to permit valid comparisons although differences noted tended to be similar to those between the 100-pound bags and the new boxes.

Skinning.--On the average, slightly more (4.4 percent) skinned potatoes were found in the 100-pound bags than in the 50-pound boxes. This difference was too small to be attributed to the containers. However, significantly more discoloration, or browning of these skinned areas, occurred in the potatoes packed in bags. The percentage of skinned potatoes found to be discolored upon arrival at the terminal markets was as follows:

Container	Percentage of skinned potatoes discolored
	Percent
100-lb. burlap bag	59
50-lb. fiberboard box	35

Previous studies conducted by the Biological Sciences Branch, U. S. Department of Agriculture, have demonstrated that moderate transit temperatures of 50° to 65° F. are desirable because they permit the early formation of new "skin" on the skinned areas; and that surface discoloration develops on skinned areas following exposure to low transit temperatures. 3/ One of these studies also showed that 50-pound boxes arranged in a chimney pattern

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3/ Ryall, A. L. Refrigeration of California Early Potatoes. Yearbook Kern County Potato Growers Assoc., 1953 (reprinted in 1955).

Table 6.--Comparison of product damage to White Rose and round red potatoes packed in 50-pound fiberboard boxes, 50-pound burlap bags, and 100-pound burlap bags, 15 test shipments, May 1957 [1]

Product damage	White Rose potatoes				Round red potatoes	
	12 test shipments		2 test shipments		2 test shipments	
	50-lb. box	100-lb. bag	50-lb. box	50-lb. bag	50-lb. box	50-lb. bag
	Percent	Percent	Percent	Percent	Percent	Percent
Skinned--not discolored:						
Slight	19.2	12.9	[2]62.6	[2]44.0	3.9	17.6
Damage	.9	1.8	9.0	0	0	0
Serious	0	0	0	0	0	0
Skinned--discolored						
Slight	11.1	20.6	15.0	19.8	0	0
Damage	.1	.4	.5	6.3	0	0
Serious	0	0	0	0	0	0
Bruising:						
Slight	.5	14.9	.4	10.2	.2	11.8
Damage	0	.6	1.2	1.4	0	0
Serious	0	.02	0	0	0	0
Greening	.5	.5	.5	.4	.2	.2
Decay	.1	.03	1.0	0	0	0

[1] One test shipment contained both red and white potatoes.

[2] This high average of "skinned--not discolored" potatoes was caused by one test shipment in which 92.0 and 85.0 percent of the potatoes packed in the boxes and bags, respectively, were slightly skinned and not discolored.

cool more slowly than 100-pound burlap bags during transit. [4] The potatoes packed in burlap bags probably cool faster because the burlap is more permeable than fiberboard, and more container surface is exposed to circulating air since the bags are not loaded as tightly as are the boxes.

The average doorway floor layer temperature at the time of arrival was 41.2° F. It appeared that the potatoes in the test shipments were over-refrigerated. The skinning data, reflecting these low temperatures, indicated that the cause for the significantly greater percentage of discolored potatoes occurring in burlap bags was probably due to their being exposed to low temperatures for a longer period of time than were the potatoes packed in the fiberboard boxes.

Although there was an increase in discoloring in the bottom layers (especially in the bags) the differences were too small to establish a definite relationship between discoloring and layer location in the load (table 7).

Table 7.--Comparison of the amount of "skinned and discolored" occurring in potatoes packed in burlap bags and fiberboard boxes, by layer position--12 test shipments, White Rose potatoes, spring 1957

Container	Layer location of containers				
	Bottom	2d	3d	4th	Top
	Percent	Percent	Percent	Percent	Percent
50-lb. boxes:					
Slight	12.1	14.6	11.2	11.1	11.2
Damage	.3	0	0	.2	0
Serious	0	0	0	0	0
100-lb. bags:					
Slight	22.0	20.8	19.5	20.9	18.2
Damage	1.1	.3	.3	.1	.2
Serious	0	0	0	0	0

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[4] Barger, W. R., and McKillop, A. A. A Railway Transportation Test with California Early Potatoes, Feb. 1957, AMS - 160. U. S. Dept. Agr. and Univ. of Calif.

Bruising.--There was substantially less slight bruising in the 50-pound fiberboard boxes than in the 100-pound burlap bags. Potatoes packed in boxes showed 0.5 percent bruising as compared with 14.9 percent in the bags. Potatoes in the boxes had no damage or serious damage by bruising. Potatoes in bags sustained 0.6 damage by bruising and 0.02 serious damage by bruising. [5]

There was also a definite relationship between the amount of slight bruising occurring in burlap bags and their layer position in the load (table 8). There was a significant increase in the amount of slight bruising from the top to bottom layer. [6] This relationship of bruising to layer location also existed for damage by bruising but the differences were not as clear-cut as those in the slight bruising category, except in the bottom layer where damage by bruising was caused by the potatoes coming in contact with the floor rack.

The total amount of bruising of all magnitudes, occurring in bag-packed potatoes, by layer location was as follows:

Layer location of bag	All bruising
	Percent
Top layer	10.3
4th layer	11.2
3d layer	14.6
2d layer	15.5
Bottom layer	21.5

Layer location did not affect the small amount of bruising that occurred in the fiberboard box.

Greening.--At the time of arrival at destination approximately 0.5 percent of the potatoes in each shipment showed small green areas.

Decay.--Decay was noted in only 3 of the 12 test shipments. The total amount was slight, and although it was slightly higher in the boxes it was of no consequence in the commercial shipments.

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[5] Analysis of variances indicated that the difference in slight bruising observed in the two containers was significant at the 1-percent level, and that the difference in damage by bruising was significant at the 5-percent level.

[6] Analysis of variance indicated that the difference in slight bruising by layer location was significant at the 1-percent level.

Table 8.--Comparison of the amount of "bruising" occurring in potatoes packed in burlap bags and fiberboard boxes, by layer position, 12 test shipments, California White Rose potatoes, spring 1957

Container	Layer location of container				
	Bottom	2d	3d	4th	Top
	Percent	Percent	Percent	Percent	Percent
50-lb. boxes:					
Slight	0.4	0.2	0.3	0.2	0.2
Damage	0	0	0	0	0
Serious	0	0	0	0	0
100-lb. bags:					
Slight	19.3	15.2	14.4	11.2	10.2
Damage	2.2	.3	.2	.04	.1
Serious	0	0	0	0	0

WHOLESALE TRADE ACCEPTANCE

The reaction of the wholesale trade to the fiberboard boxes was generally favorable. The wholesalers visited agreed that the fiberboard boxes (1) carried the potatoes well, with less bruising and less discoloration, (2) were handled more gently than bags because they were lighter and more compact, and (3) were more attractive and displayed the potatoes to better advantage than the bags did.

A frequent comment made by wholesalers was that the fiberboard box afforded the potatoes more protection from greening than the burlap bag.

A few wholesalers thought that the extra cost might be a problem; and one wholesaler, in the face of a rapidly declining market, claimed that there was serious buyer resistance to the premium price asked for the potatoes in boxes. For the most part, though, the trade did not seem unduly worried about the extra cost, feeling that the additional protection, handling convenience, and sales appeal made the extra cost worthwhile. Two of the more interesting comments were as follows:

A wholesale merchant in Ohio:..."Can prepackage, and then place the packages in the box. This protects the packages from rough handling and keeps them from 'greening'...Bulk display in box made a good retail display."

A wholesale merchant in Pennsylvania:..."I especially like the box because we bag potatoes and then place the bags in the box. This way, because they can see the brand, the buyers know that we are bagging good quality potatoes."

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